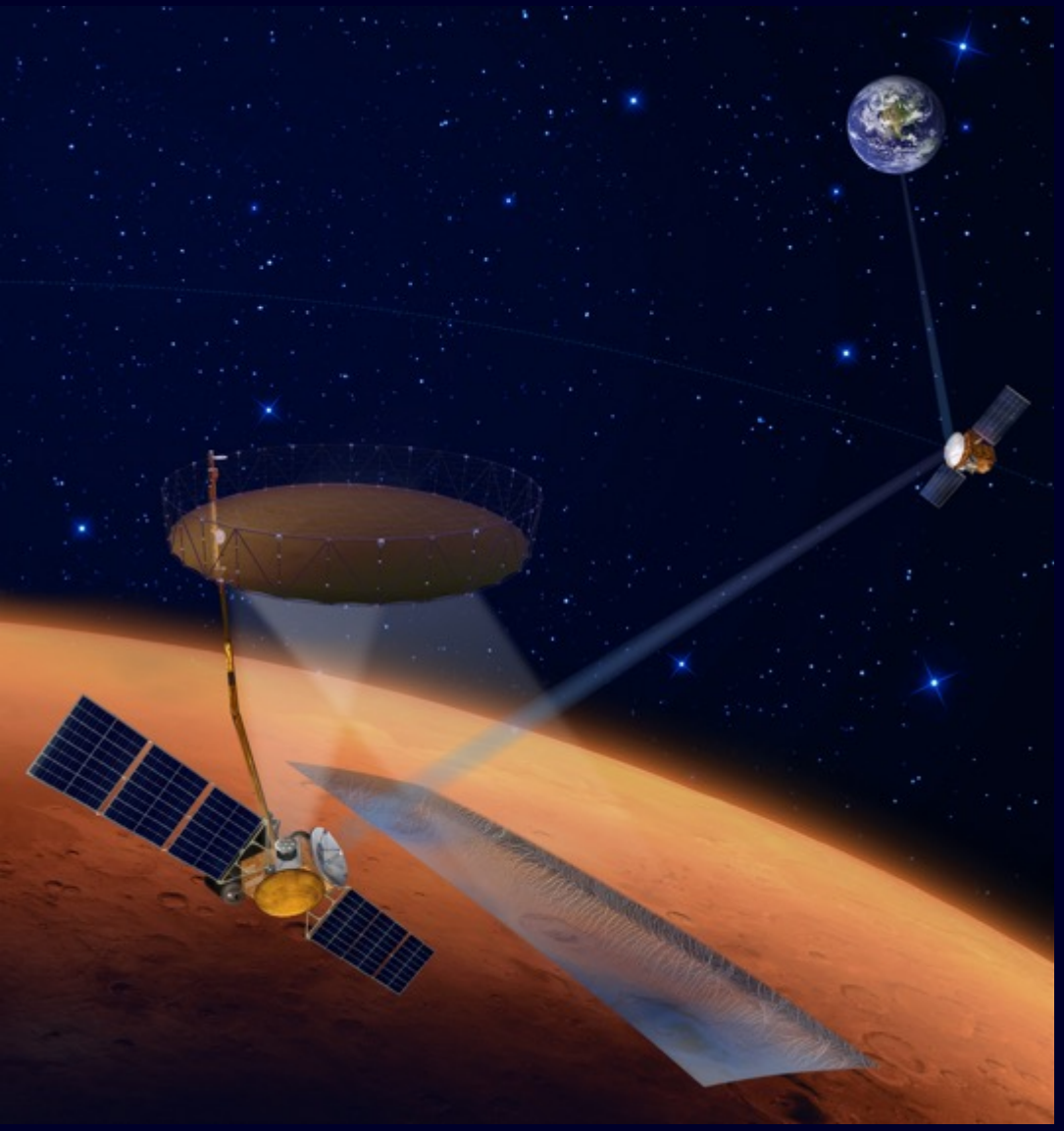
International
MARS Ice Mapper
Seeking Locations for Our First Human Home on Mars



International Mars Ice Mapper Mission

Measurement Definition Team (MDT)
Overview + Status

Tim Haltigin

Canadian Space Agency, MDT Executive Committee

Michèle Lavagna

Politecnico di Milano, MDT Co-Chair

Jeff Plaut

Jet Propulsion Laboratory/California Institute of Technology, MDT Co-Chair

Michelle Viotti

Jet Propulsion Laboratory/California Institute of Technology, MDT Executive Committee Technical Team

This is an update on the status of the Mars Ice Mapper Measurement Definition Team.
This presentation has been reviewed and determined not to contain export controlled technical data.
It does not represent the views of the organizations that employ any of the members of the analysis team.

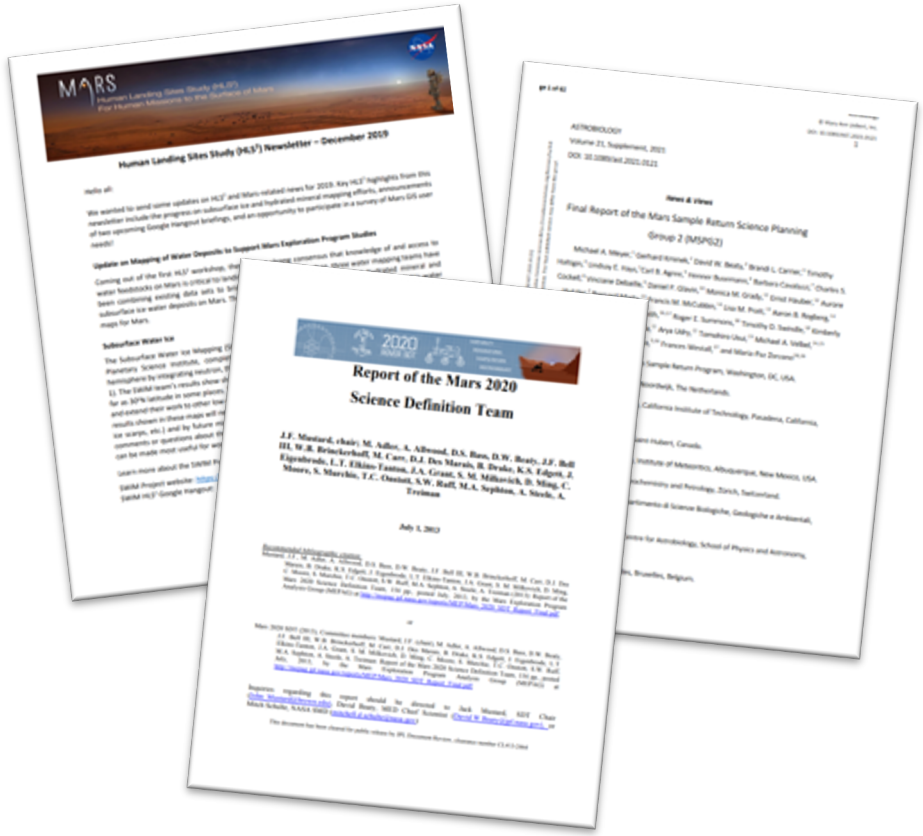
Approach to team composition and activities builds from prior experience.

Philosophy

- Draw from experience where possible, innovate where necessary

Key Precedents

- Mars 2020 Science Definition Team (M2020 SDT)
- Mars Sample Return Science Planning Group 2 (MSPG2)
- Human Landing Sites Study (HLS^2)



Open Competitive Process

- August 2021: "Dear Colleague" letter and MDT Charter posted inviting international applicants
  - ➢ 147 highly qualified applications received
- November 2021: Team selections finalized

Team Composition

- Expertise spread across planetary and science and human exploration
- 10 countries represented
- Diversity across gender and career stage

Additional information on MDT process at: https://science.nasa.gov/researchers/ice-mapper-measurement-definition-team

I-MIM MDT IMPLEMENTION

Michèle Lavagna / Jeff Plaut, Co-Chairs

MDT VS SDT

Recon/Science *Measurement* Definition Team differs from traditional SDT.

Traditional SDT Process:

- a Science Definition Team (SDT) defines mission objectives, observation requirements, and a notional payload suite

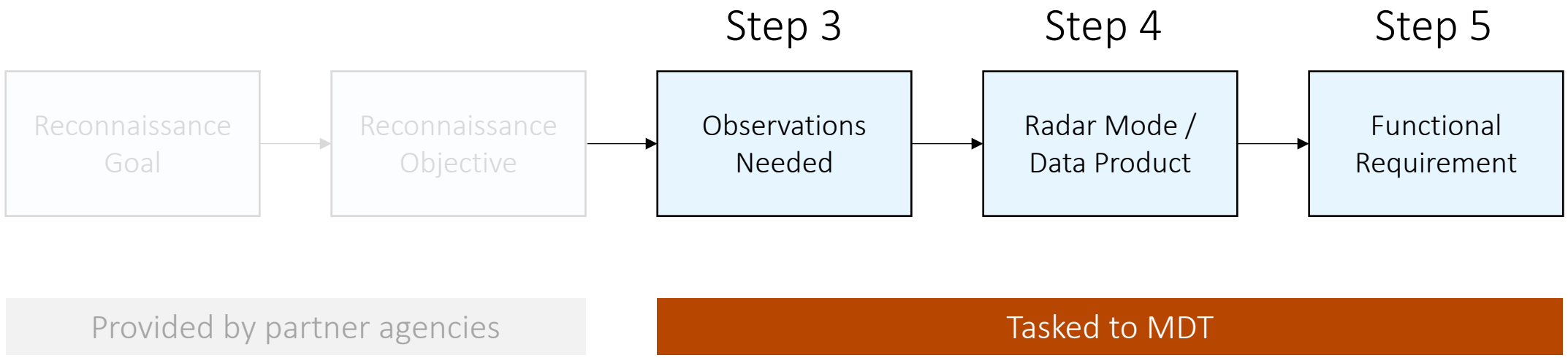
For I-MIM:

- Agency partners have agreed upon preliminary Mission Concept goals, objectives, and spacecraft/payload assumptions to reflect both common and unique national reconnaissance and science goals for Mars exploration
- The MDT brings together the traditional planetary science community AND users of the requirements-driven reconnaissance *measurement* data for human mission planning

MDT Ground Rules & Assumptions

- Core mission requirements are reconnaissance-driven
- Primary anchor payload is a compact-polarimetric L-band SAR/Sounder
- Agency partners are committed to maximizing return on investment through high value, investigation-driven supplemental science and mission-support objectives

I-MIM MDT: MEASUREMENT TRACEABILITY MATRIX (MTM) ROADMAP



MDT ORGANIZATIONAL STRUCTURE

Program Executive
RICHARD (RICK) DAVIS

Ex Officio
MARTIN BERGERON (CSA)
MICHAEL MEYER (NASA)

MDT Executive Committee

CANADA	ITALY	JAPAN	US
TIM HALTIGIN	RAFFAELE MUGNUOLO	TOMO USUI	MIKE KELLEY

Independent Assessment Team

ENRICO FLAMINI
JIM HEAD
GORO KOMATSU
RALPH LORENZ
MICHAEL MISCHNA

+ Possible Human Spaceflight Rep

Facilitation / Technical Support
ELEANORA AMMANNITO, DAVID HOLLIBAUGH BAKER, TAKANORI IWATA, SATORU OZAWA, PATRICK PLOURDE, MICHELLE VIOTTI

Co-Chairs
MICHÈLE LAVAGNA | JEFF PLAUT

ALI BRAMSON - Assistant Co-Chair

Logistics
LAURA RATLIFF, BOB COLLOM

Core Reconnaissance / Science Team

AHARONSON	BRAMSON	GOLOMBEK	IESS	MIYAMOTO	PEARCE	TAMPPARI
ANDERSON	BYRNE	GRANT	IMAMURA	MUNK	PUTZIG	THOMAS
AO	CALVIN	GRIMA	KUMAMOTO	NAKAGAWA	SEKI	WHYTE
BERNARDINI	DALY	HAMRAN	LEVY	NEISH	SEKINE	
	FERRARI	HARKNESS	LILLIS	OROSEI	SIBILLE	
	FRIGERI	HOFFMAN	MAEZAWA	PATTERSON	SMITH	

Early Career Group

AOKI	BUTCHER	GENOVA	HIBBARD	LALICH	SARGEANT
BICKEL	GANESH	HARRINGTON	KUROKAWA	NEROZZI	STUURMAN

Team member nationality and description of expertise available at:
https://science.nasa.gov/science-pink/s3fs-public/atoms/files/MDT%20Selectees%20List.pdf

Appointed by partner agencies | Selected from applicants | Appointed by partner agencies or selected from applicants

MDT STATEMENT OF WORK

We Are Here

Task 1: Core Reconnaissance Mission

- Provide detailed measurement requirements traceable to mission reconnaissance goal/objectives for anchor radar payload
- If radar payload is not uniquely capable of satisfying the reconnaissance objectives, identify measurements that are required and propose additional payload(s) to meet the requirements

Task 2: Potential Mission Augmentation Options to Maximize Return on Investment

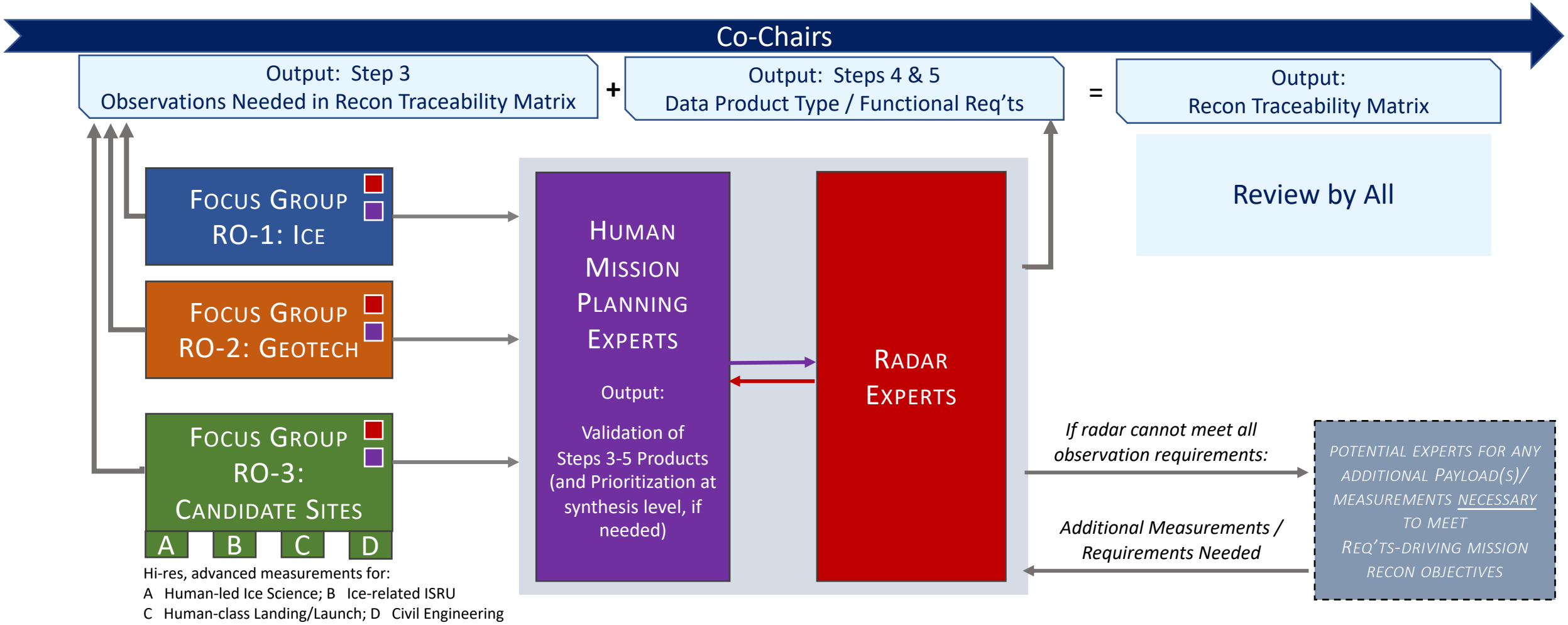
- Define additional recon and science objectives that could be met with reference payload
- Assess and prioritize technical and scientific options for augmenting the core mission
- Feasibility assessment of supplemental payload(s) and/or modest modifications to recon payload(s)

Task 3: Concept of Operations

- Prepare a model operational concept based on findings from Tasks 1 and 2

ORGANIZATION & PROCESS FOR TASK 1
CORE RECONNAISSANCE MISSION

1. FOCUS GROUPS: Organized by Recon Objective. — Define Questions and Observations Needed. (Radar/Human Mission Experts embedded in each.)
2. HUMAN MISSION PLANNING EXPERTS: — Validate key questions and observations needed.
3. RADAR EXPERTS: — Turn questions/observations into functional instrument requirements.
4. ALL: — Generate recon traceability matrix that lead to mission requirements definitions.



NOTIONAL MDT SCHEDULE

All | ASI | CSA | JAXA | NASA | NSO?

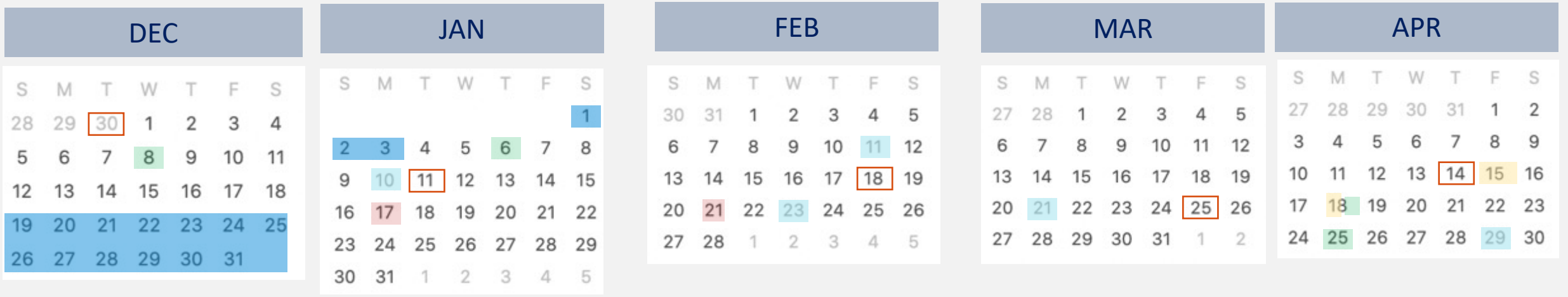
MDT Tasks 1-3 Phasing

Early Organization

Heavy SAR Focus/Recon Requirements driven; Recon Con Ops

Extended Use of SAR for Science & Additional Payloads/Rideshares ConOps

Final Report Prep



NOV 30
Kickoff

DEC
Background Briefings

JAN 11
New Year Start

~ 5.5 weeks

FEB 18
Interim Report

~ 5 weeks

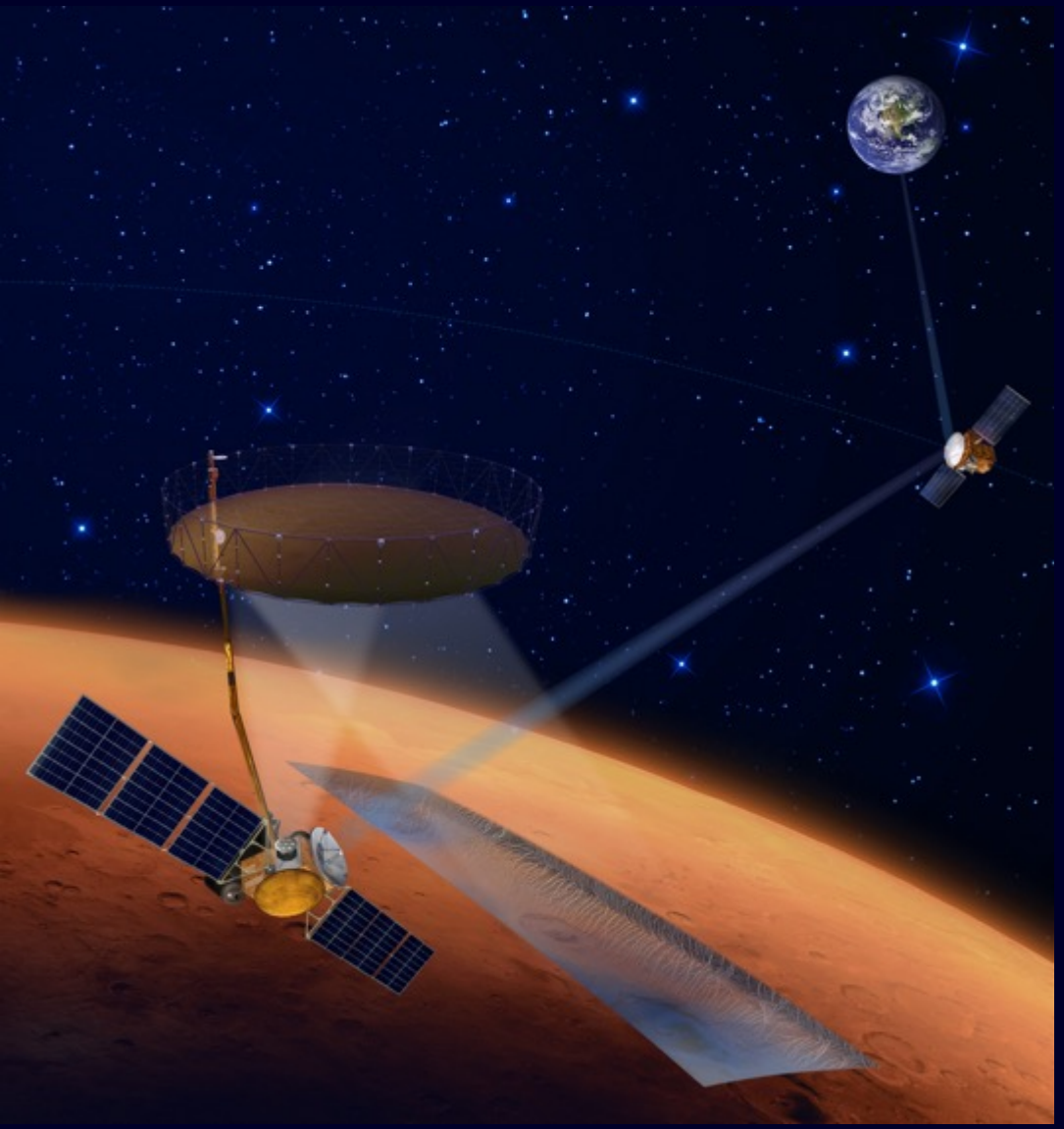
MAR 25
Near-final Summary

~ 3 weeks

APR 14
Final Report*

SUMMARY

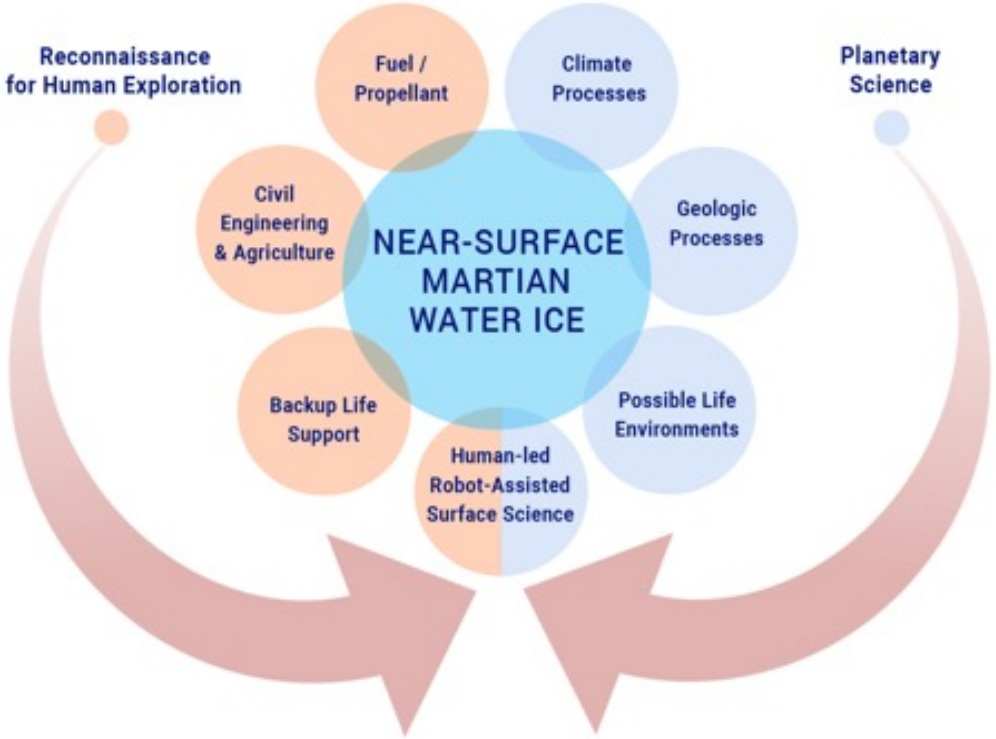
- I-MIM Measurement Definition Team (MDT) was competitively selected from around the world
- MDT Final Report expected in April and will be shared with the MEPAG community
- Future opportunities on I-MIM Recon/Science Team after a potential Phase A start



Backups

IMPORTANCE OF SUBSURFACE ICE

Ice detection leads to eventual convergence in a future sustained human-robotic presence on Mars.



- Critical both for Mars reconnaissance-driven measurements for the human exploration of Mars and for planetary science priorities
- Human-exploration and science objectives will eventually converge when human explorers are able to live and work on the Martian surface,

AGENCY-LEVEL EXPLORATION-DRIVEN GOAL (DRIVES REQUIREMENTS)

Map and characterize accessible subsurface (top 10m) ice and its overburden in mid-to-low latitudes to support planning for the first potential human surface missions.

RECONNAISSANCE OBJECTIVES

In the Reconnaissance Zone (RZ*):

RO-1	RO-2	RO-3
Where is the ice? How much is there?	What is the nature of the regolith above the ice?	What specific considerations are required to characterize potential candidate sites for human exploration?

***RECONNAISSANCE ZONE (RZ)**: *Midlatitude, low elevation, terrain-favorable areas on Mars where human exploration is likely viable in terms of human-led surface science potential, in-situ resource utilization, engineering constraints associated with landing and surface operations, and other such factors.*

AGENCY-LEVEL SUPPLEMENTAL VALUE GOAL (MAXIMIZES RETURN ON INVESTMENT)

As possible, provide *high-value science opportunities* and *high-priority mission-support capabilities* that serve both reconnaissance and science.

SUPPLEMENTAL SCIENCE OBJECTIVES	SUPPLEMENTAL MISSION SUPPORT OBJECTIVES
Within mission boundary conditions (recon req'ts, budget, schedule, operational complexity, partner commitments):	
What additional scientific investigations can be conducted?	What supplemental technologies / recon/science payloads could be included?

CURRENT PARTNER AGENCIES

Primary Payload

- L-band compact polarimetric SAR/Nadir SAR Sounder

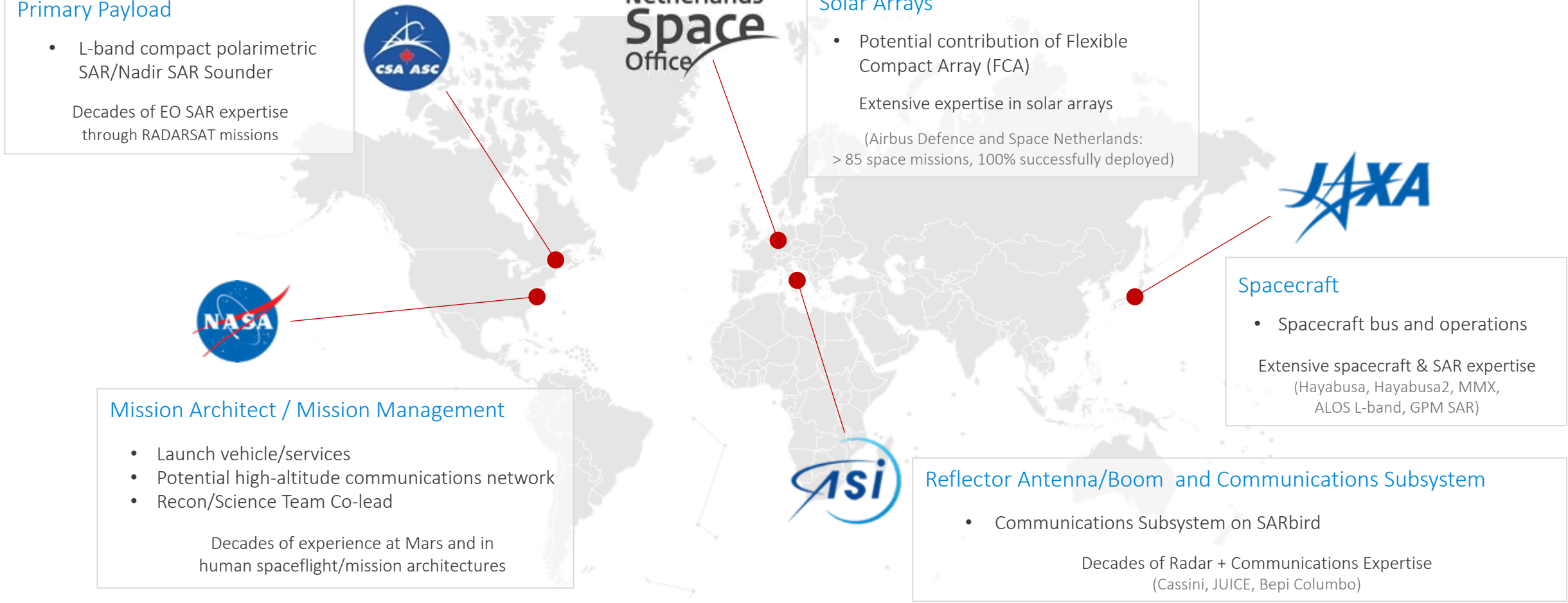
Decades of EO SAR expertise through RADARSAT missions

Solar Arrays

- Potential contribution of Flexible Compact Array (FCA)

Extensive expertise in solar arrays

(Airbus Defence and Space Netherlands: > 85 space missions, 100% successfully deployed)



Spacecraft

- Spacecraft bus and operations

Extensive spacecraft & SAR expertise
(Hayabusa, Hayabusa2, MMX, ALOS L-band, GPM SAR)

Mission Architect / Mission Management

- Launch vehicle/services
- Potential high-altitude communications network
- Recon/Science Team Co-lead

Decades of experience at Mars and in human spaceflight/mission architectures

Reflector Antenna/Boom and Communications Subsystem

- Communications Subsystem on SARbird

Decades of Radar + Communications Expertise
(Cassini, JUICE, Bepi Columbo)

Concept Team roles only; partners have not yet made formal commitment. Additional Partners are possible.